glycerides, and that the percentages of oleic, linoleic and linolenic acids present were 62.8, 10.9, and 5.8 respectively.

The differences in bear fats reported in the literature probably reflect differences in the food fat consumed during the fattening process.

LITERATURE CITED

(1) A. O. A. C. 5th Ed., 1940, Chap. 31, Oils, Fats and Waxes.
(2) Hooper, David, The Fat of the Himalaya Bear (Ursus torquatus Wagner), Pharmaceutical Jour. (4) *26,* 803-4, through Chem. Zentr. *2,* 336 (1908).
(3) Hoyt, L. F., Bear Grease, Oil and Soap, *11,* 85 (1934).
(4) Itagaki, S., Bear Fat, J. Pharm. Soc. Japan, *522,* 743 (1925) through C. A. *20,* 2590 (1926).
(5) Jensen, L. B., Microbiology of Meats, The Garrard Press, Champaign, Ill., 1942, Page 9.
(6) Kephart, Horace, Camping and Woodcraft, New Ed. 1930, MacMillan, New York, Page 331.
(7) Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats and Waxes, MacMillan & Co., Ltd., London, 1909, Page 37-44.
(8) Maynard, L. A., Animal Nutrition, 1st Ed. 1937, McGraw-Hill, New York, Page 74.
(9) Raikow, P. N., Analyse eines Barenfetts, Chem. Zeitung, *28,* 272 (1904).
(10) Schneider, C. and Blumenfeld, S., Beitrag zur Kenntnis Animalscher Fette, Chem. Zeitung, *30,* 53 (1906).
(11) Ueno, Seiichi, and Kuzei, Nobuo, Studies on Terrestrial Animal Oils and Fats 3, J. Soc. Chem. Ind. Japan, *32,* 312 (1929).

The Solubility of Gases in Butter Oil, Cottonseed Oil, and Lard

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Introduction

There appears to be no literature concerning the solubility of the common gases in butter oil and very little in connection with the other edible oils and fats. Schmidt-Nielsen (1) reported the solubility of air in various oils and, later, Vibrans (2) determined the solubility of the common gases in cottonseed oil, corn oil, lard, and hydrogenated cottonseed oil shortening.

The present work was undertaken in view of the desirability of having solubility data on butter oil and because of the scarcity of data on other fats and oils. The solubility of air, hydrogen, oxygen, nitrogen, and carbon dioxide was determined in butter oil, cottonseed oil, and lard.

Experimental

With the exception of air, the gases were taken directly from commercial cylinders and were used without purification. The butter oil was obtained from butter prepared from fresh cream in the laboratory. The cottonseed oil and lard were good grade commercial products.

The apparatus consisted of a reaction flask of 125 ml. capacity connected to a water jacketed gas burette provided with mercury leveling bulb and a differential manometer containing dibutyl phthalate. The reaction flask was suspended by means of a thick walled rubber tube into a hot air bath maintained thermostatically to within ± 0.5° C. An externally mounted motor with a crank arm movement was connected to the reaction flask to provide shaking. The system was provided with a connection to a vacuum pump for evacuating the reaction flask. All samples consisted of 50 ml. oil measured at the temperature of the experiment. The solubilities in all cases were determined at 40°C. In addition, the solubility of gases in butter oil was also determined at 60° C.

The preliminary preparation of the oils consisted of evacuation to a pressure of about one mm., heating to a temperature of approximately 85° C. and shaking vigorously to remove all dissolved gases. The oil was then allowed to cool under vacuum to the temperature at which the experiment was conducted. Shaking was then discontinued and the gas was allowed to enter the reaction chamber from the gas burette and the leveling bulb adjusted so as to provide a pressure of the gas on the surface of the oil equal to atmospheric pressure. It was assumed that there was no surface solution of the gas during the few seconds required to make the zero reading on the gas burette. Shaking of the sample was then begun and the leveling bulb continuously adjusted so as to provide a pressure just slightly in excess of atmospheric pressure until there was no apparent absorption. The pressure was adjusted to atmospheric and the shaking of the sample continued. The pressure was adjusted at intervals if necessary in order to maintain a pressure equal to that of the atmosphere. After shaking for approximately one hour a reading of the burette was taken. The difference between this reading and the zero reading was taken as the volume of the gas dissolved by the 50 ml. of oil at the prevailing temperature of the gas burette and atmospheric pressure.

Results

All results shown are averages of at least two determinations and are expressed in terms of milliliters of gas under standard conditions (0° C. and 760 mm.) dissolved under atmospheric pressure in 100 milliliters of the oil. Differences in the values of three determinations were not over three-tenths of one percent, and in most cases were considerably less than this value.

TABLE I

The Solubility of Gases in Butter Oil, Cottonseed Oil, and Lard

Gas	Ml. gas dissolved in 100 ml. of Fat			
	Butter Oil		Cottonseed Oil	Lard
	40° C.	60° C.	40° C.	40° C.
	ml.	*ml.*	*ml.*	*ml.*
Oxygen	14.2	12.7	12.7	11.5
Nitrogen	8.9	7.9	6.2	6.6
Hydrogen	5.4	6.8	4.7	5.0
Air	10.1	9.6	8.7	8.8
Carbon Dioxide	109.5	91.0	87.6	100.3

In addition to the above data runs were also made on butter oil at 25° C. However, the oil was semiplastic and consistent results could not be obtained and were therefore not reported.

Discussion and Conclusion

The solubility of hydrogen, oxygen, air, nitrogen, and carbon dioxide is slightly greater in butter oil than in cottonseed oil and lard at 40° C. The solubility of all the gases except hydrogen decreases when the temperature of the oil is increased from 40° C. to 60° C. Hydrogen in butter oil follows the behavior of the rare gases, as described by Lannung (3), who showed that the solubility of the rare gases and hydrogen when dissolved in organic solvents increased with increase in temperature. The results obtained in the present experiments are slightly higher in value than those obtained by Vibrans (2), except in the case of the solubility of carbon dioxide in cottonseed oil in which case they were slightly lower in value. The values obtained for the solubility of carbon dioxide in lard in the two cases were approximately the same. Vibrans conducted his experiments at 45° C. rather than at 40° C. as in the present experiment. The only result of the present investigation which is comparable to those of Schmidt-Nielsen (1) is the solubility of air in cottonseed oil. This author's results are slightly lower than those reported herein. However, the temperature used was 50° C., or 10° C. higher than that used by the present authors. In experiments conducted in these laboratories on the removal of gases from fats, it was found that vigorous shaking in a high vacuum at a temperature close to 100° is necessary for complete removal of all dissolved gases. It is believed that our results were higher than those of others because of a more complete removal of dissolved gases from the fats, before solubility measurements were made.

BIBLIOGRAPHY

(1) Schmidt-Nielsen, S. Academia Scientianum Fennica Annales. a-29 (1927).

(2) Vibrans, F. C. Oil and Soap, *12*, 14-15 (1935).

(3) Lannung, A. Jour. Am. Chem. Soc., *52*, 68 (1930).

Report of the Color Committee
1942-1943

Due to the fact that all of the members of the committee have been unusually busy, no actual committee work has been done, but we have considered several problems related to progress in the evaluating of oils for color.

The most important item of unfinished business that has been before the committee is an improved colorimeter which can be adopted by the society for use in the official grading of vegetable oils. Although several instruments have been tentatively proposed in the past for this purpose, the only real progress that has been made in the last two years has resulted from work done by the Spencer Lens Company; first, through Dr. R. S. Estey, and during the current year, Dr. Morden G. Brown. An experimental model of an instrument was sent around to members of the committee during the 1941-42 season, and although it did not meet with general approval, it has served as a basis, for the consideration of the present committee, of the features that seem desirable in a colorimeter.

The committee, therefore, makes the following recommendations:

1. The manufacturer of a colorimeter, to be submitted for adoption as a standard instrument for the American Oil Chemists' Society, should not be so limited as to the selling cost of the instrument as to prevent incorporating in it desirable and necessary optical and mechanical features; on the other hand, of course, the cost must not be so prohibitively high as to prevent its universal adoption. An oil colorimeter is used for commercially evaluating oils, and small differences in color, which can easily result from the use of an inefficient instrument, cause wide variations in values established by color tests. We believe that no referee or plant laboratory would object to paying a fair price for a satisfactory instrument.

2. The majority of the committee is in favor of incorporating in the instrument a mechanical means of introducing the color glasses into the field of vision. It is thought that this will avoid breakage and scratching of the glasses and the soiling of their surfaces as is almost unavoidable when they are used manually. A minority of the committee feels that this mechanical feature might make the cost of the instrument unnecessarily high and that it should be optional. There is no objection to this except that the construction of two different models might make each of them cost more than would be the case if one model could be definitely agreed upon and adopted. One member suggests that the glasses and mechanism for changing them might accumulate a film of grease or dirt in a plant control laboratory and require frequent cleaning. This is probably a matter of design and construction of the instrument and should be considered by the manufacturer. It hardly seems probable that such a possibility would compare with the known difficulties of manual changing of glasses.

3. The committee believes that a mechanical means of introducing the color tubes into the field of vision is desirable but not necessary and that that can best be left to the discretion of the manufacturer, provided, of course, that if the color tubes are to be placed in the instrument singly the construction should be such that this can be easily done and without risk of soiling with dripping oil the optical parts of the instrument.

4. The committee believes that the optical details of the instrument, insofar as its development is concerned, should be left to Dr. Morden G. Brown and the Spencer Lens Company with the collaboration of Mrs. Geraldine W. Haupt, of the Bureau of Standards.

5. The committee is not unanimous in regard to incorporating in the instrument a means for varying and controlling the brightness of the field. Some of the members believe that this would cause confusion and variations in color determinations even greater than those which now occur as a result of not being